

In Section 5, the major alternatives for increasing runway capacity at SFO and OAK airports are described. Using SIMMOD and the forecasted flight schedules for 2010 and 2020, the impacts on delay resulting from each alternative are quantified and discussed.

5.1 SAN FRANCISCO RUNWAY OPTIONS

In 1999, the SFO-Runway Reconfiguration Study examined a series of alternative runway configurations for SFO that could reduce aircraft delay (and noise impacts) on surrounding residents. The study identified 32 runway options. Following a thorough technical evaluation, three alternatives were determined to be worthy of further study and are the subject of the analysis in this section. These alternatives are designated A3, F2, and BX Refined (BXR).

5.1.1 Alternative A3

As shown in Figure 5-1, alternative A3 includes several changes to the existing runway system at SFO:

- A new runway 28R is added with a length of 9,430 feet and separated from runway 28L (the old 28R), by 4,300 feet. This separation allows simultaneous independent arrivals in IFR conditions, thereby maintaining dual runway capacity in poor weather.
- Existing runway 28L is converted to use as a taxiway. (SFO is also considering intermittent use of 28L as a departure runway under certain weather conditions.)
- Under West Plan flow conditions, dual arrivals do not have to be paired to land on 28R and 28L in both VFR and IFR weather. Arrivals in VFR on 28R will be spaced more closely than those on 28L (since 28R has no intersection, there is no need to leave a gap for departures). In IFR, however, the spacing of arrivals on 28R has to be increased in order to have sufficient protection for missed approaches. Most departures will use 01L and 01R for take-offs with the exception that some heavy long-range flights will still need to use 28L for departure.

As shown in Figure 5-2, under Southeast Plan flow conditions, alternative A3 includes the following operating procedures:

- Arrivals land on Runway 19L
- Departures takeoff from runway 10L and 10R, depending on destination
- For heavy long-haul flights, runway 10R (old runway 10L) is used for departure

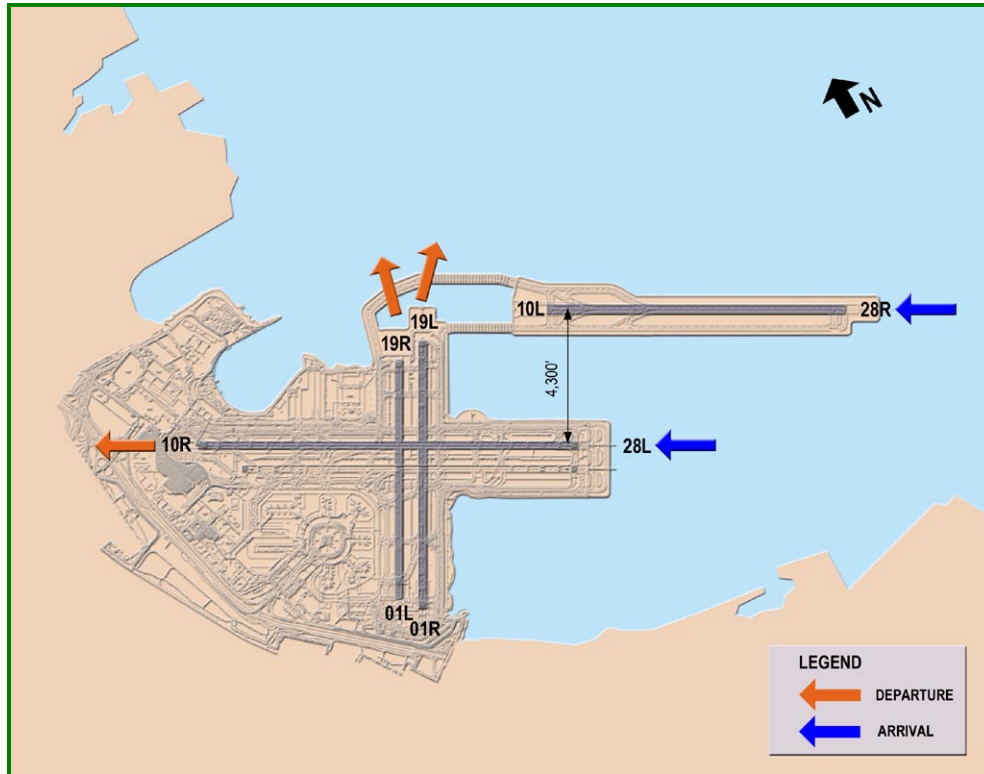


Figure 5-1 Alternative A3 West Plan VFR/IFR

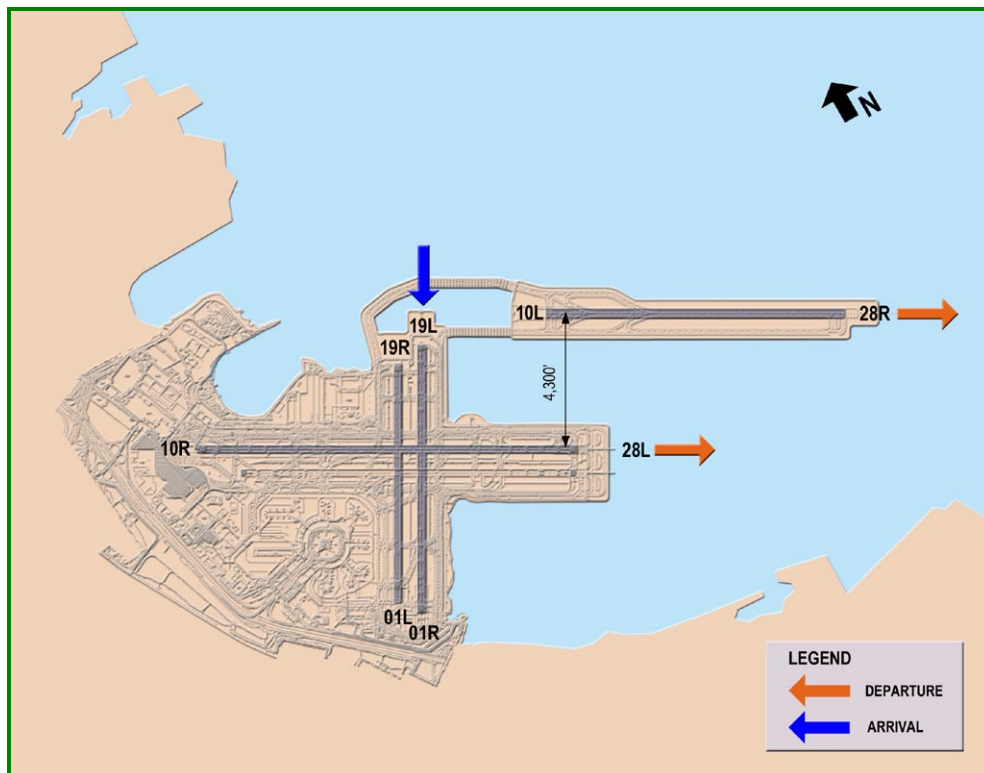


Figure 5-2 Alternative A3 Southeast Plan IFR

5.1.2 Alternative F2

As shown in Figure 5-3, alternative F2 includes several changes to the runway system at SFO:

- A new runway 28R/10L is added with a length of 9,430 feet and separated from runway 28L/10R by 4,300 feet. This separation allows simultaneous independent arrivals in IFR conditions, thereby maintaining dual runway capacity in poor weather.
- A new runway 01L/19R is added 4,300 feet west of existing runway 01R with a length of 11,500 feet.
- Runway 01R is extended north to a total length of 12,350 feet, and the departure threshold is moved 3,350 feet to the north. Extending the runway and displacing the threshold minimizes noise impacts while still maintaining a usable length of 9,400 feet for departures.
- Existing runways 01L and 28L will be converted to use as taxiways.

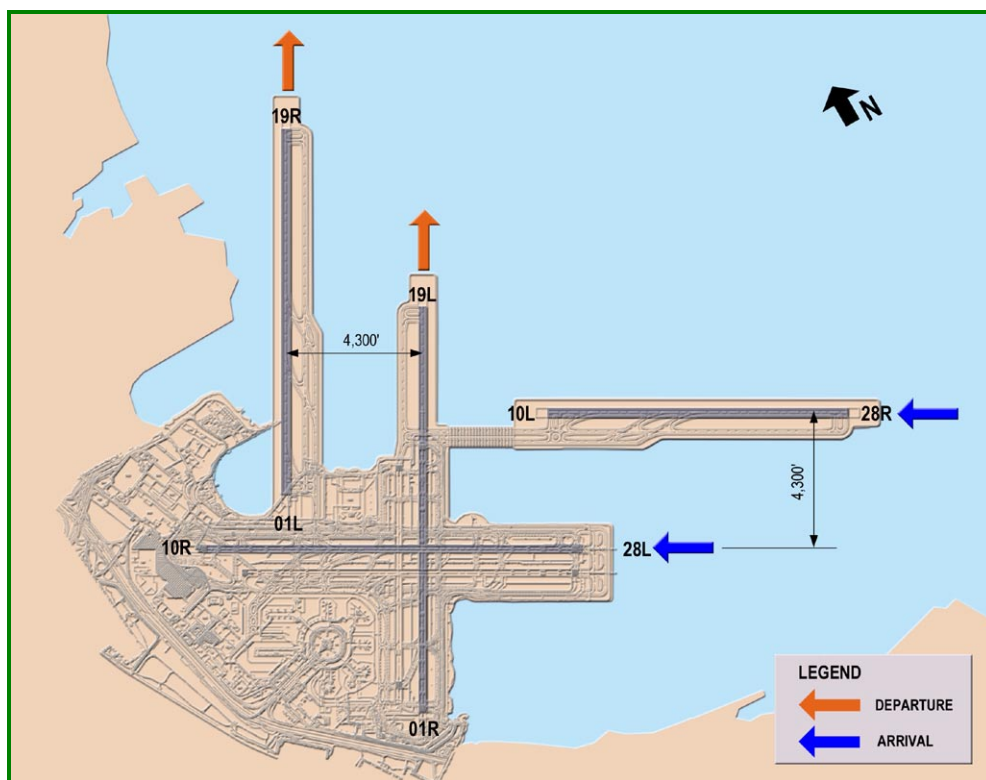


Figure 5-3 Alternative F2 West Plan VFR/IFR

Under West Plan flow conditions, the following procedures would be used:

- Arrivals will use runways 28L and 28R
- Departures will use runway 01L and 01R
- Heavy long-haul departure flights will primarily use the new runway 01L

As shown in Figure 5-4, under the Southeast Plan flow pattern, the following procedures would be used:

- Arrivals land on Runway 19L
- However, due to conflicts with approach to OAK runway 11 during Southeast flow, arrivals cannot use the new runway 19R, thereby losing the ability to use both 19L and 19R for arrivals
- Departing flights use Runways 10L and 10R, depending on destination
- Heavy long-haul flights use 10R for departures

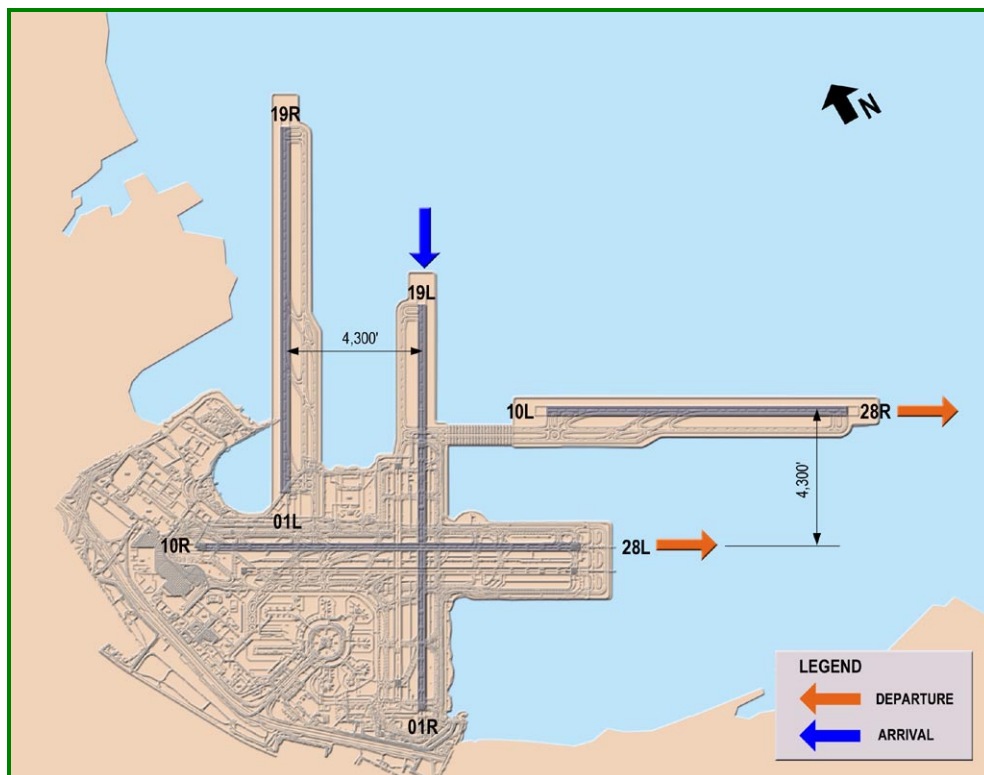


Figure 5-4 Alternative F2 Southeast Plan IFR

5.1.3 Alternative BXR

As shown in Figure 5-5, alternative BXR includes the following changes to the existing runway layout at SFO:

- A new runway 28R/10L is added with a 4,300 feet separation from runway 28L/10R with a length of 9,430 feet, allowing simultaneous independent arrivals.
- A new runway 01R/19L is added 3,400 feet east of existing runway 01R with a length of 9,400 feet.
- Existing runway 01R is re-designated as runway 01L and is extended north to a total length of 14,850 feet. The departure threshold is displaced 3,350 feet north to minimize noise impacts, giving a usable departure length of 11,500 feet.
- Existing runways 01L and 28L are used as taxiways.

As shown in Figure 5-5, under West Plan VFR and IFR procedures:

- Arrivals use runway 28R and 28L
- Departures use runways 01L and 01R
- Departures for heavy long-haul flights use runway 01L

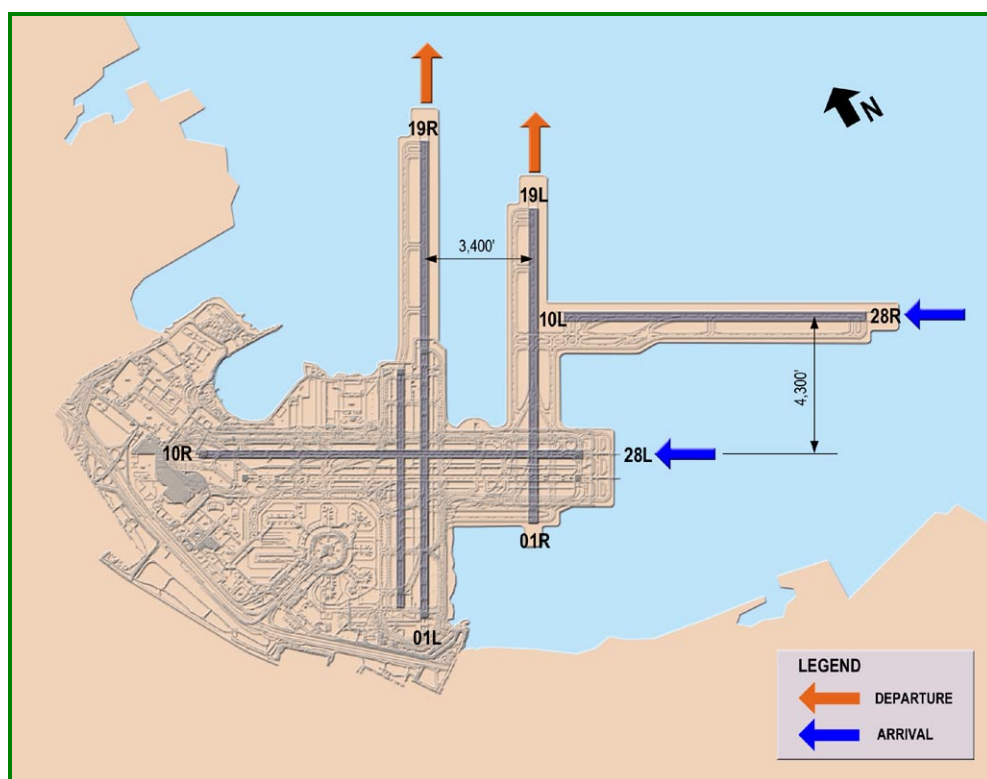


Figure 5-5 Alternative BXR West Plan VFR/IFR

As shown in Figure 5-6, under Southeast Plan procedures:

- Arrivals use runways 19R and 19L
- Departures use 10R and 10L depending on destination
- Departures for heavy long-haul flights use 10R

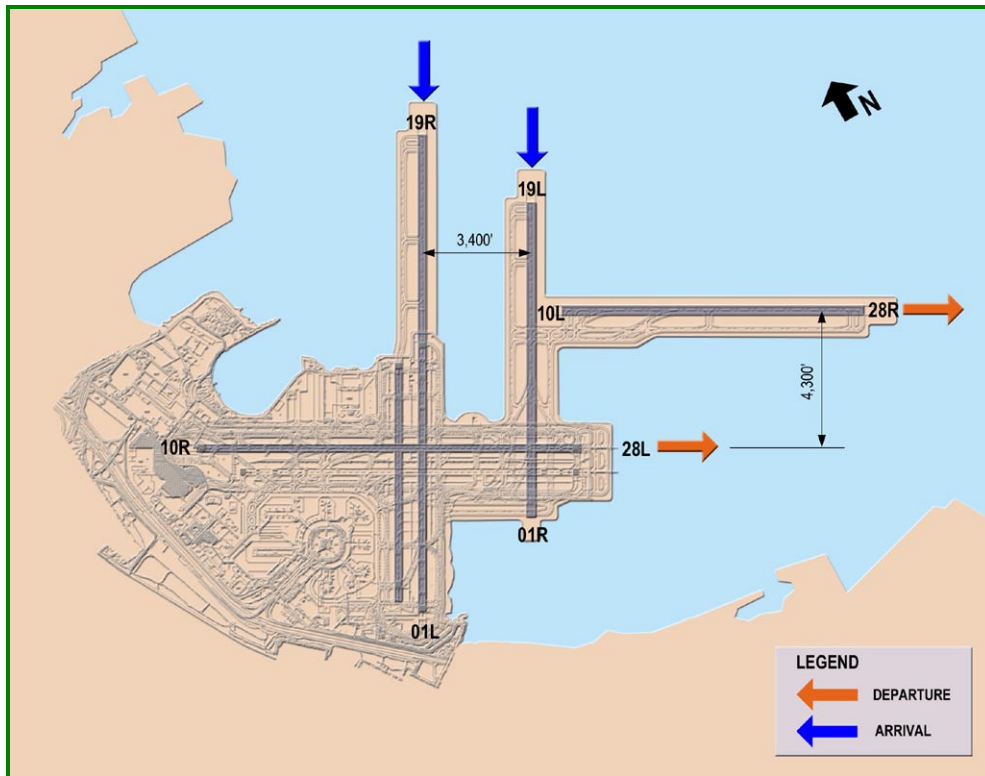


Figure 5-6 Alternative BXR-Southeast Plan

5.2 OAK RUNWAY OPTIONS

As discussed earlier in Section 3 and shown in Figure 5-7 below, the existing runway configuration for OAK consists of a single commercial air carrier runway 11/29 (South Field) and limited use of 9L/27R (North Field) for some air cargo operations. Two alternatives have been modeled for adding runway capacity at OAK, including development of a second commercial air carrier runway approximately 500 feet north of 11/29, called the “inboard” alternative, or development of a new runway 4,300 feet south of 11/29, called the “outboard” alternative.

5.2.1 Inboard Runway Alternative

As shown in Figures 5-7 and 5-8, the inboard alternative would be a closely spaced parallel runway to 11/29. For simplicity in modeling the runways and airspaces it was assumed that these runways are used in a dedicated mode – one for arrivals, one for departures. Operating conditions for the West and Southeast Plans are shown in the following figures indicating arrival and departure use.

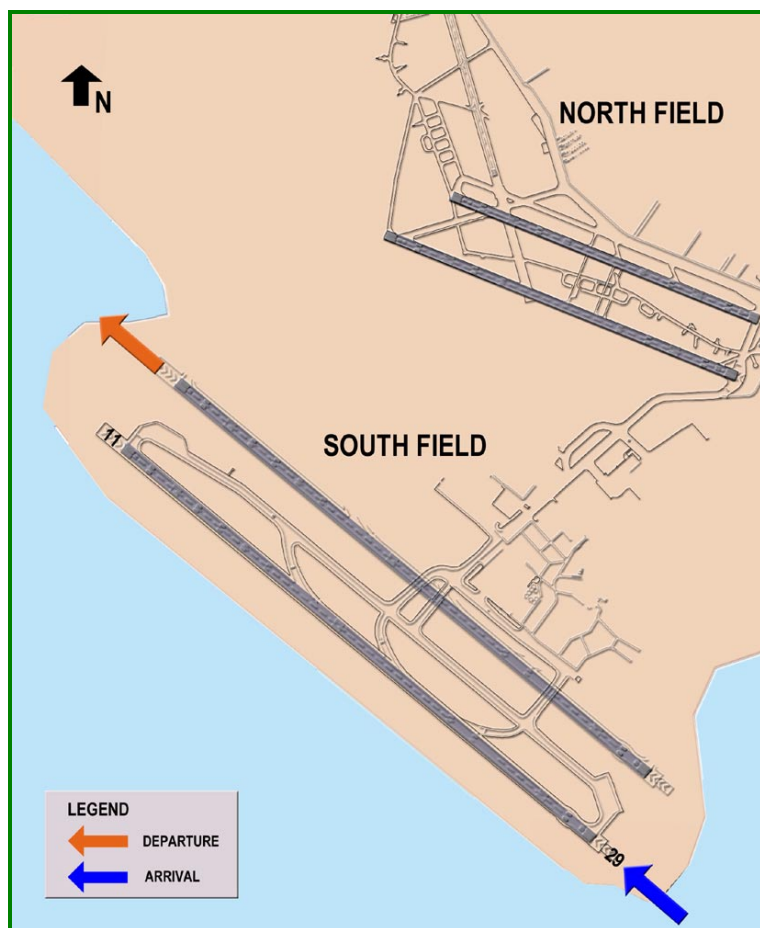


Figure 5-7 OAK Inboard West Plan Alternative

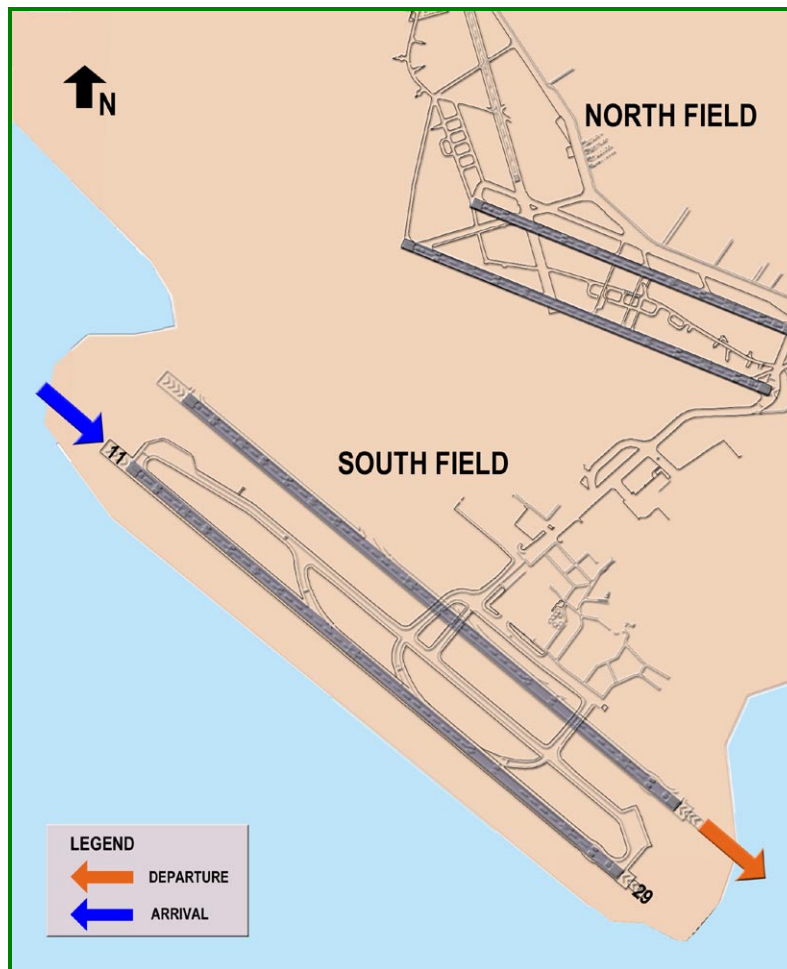


Figure 5-8 OAK Inboard Southeast Plan Alternative

5.2.3 Outboard Runway Alternative

As shown in Figures 5-9 and 5-10, the outboard alternative would allow simultaneous independent runway operations. This alternative would roughly double OAK's runway capacity during both VFR and IFR conditions. Operating conditions for the West and Southeast Plans are shown in the figures indicating arrival and departure use.

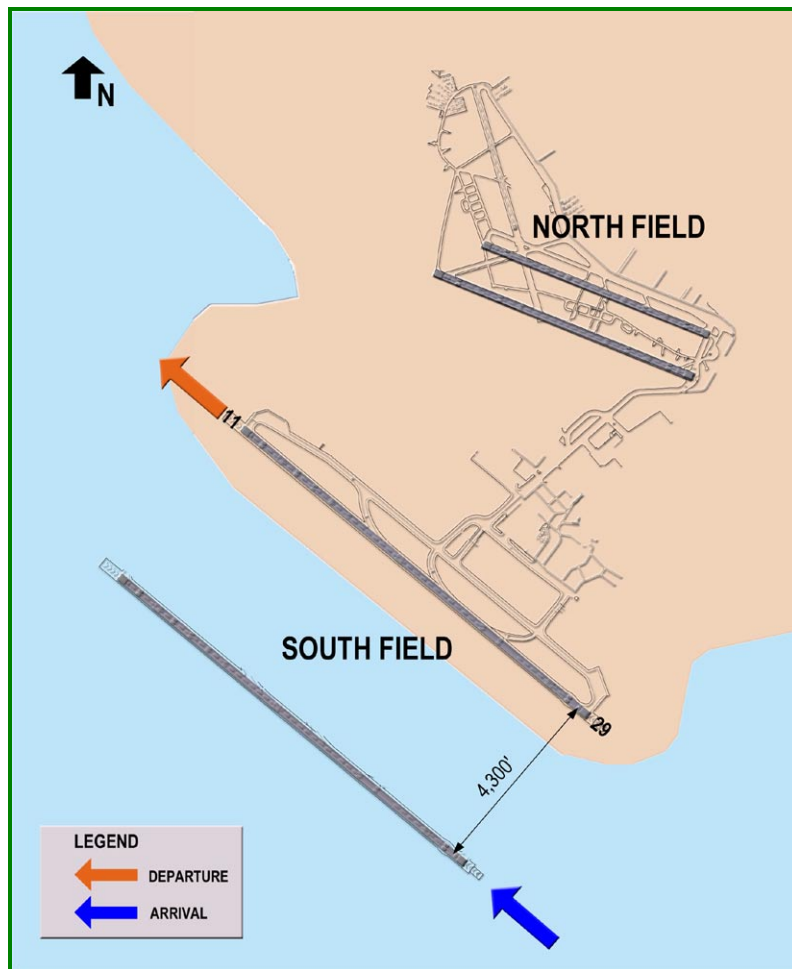


Figure 5-9 OAK Outboard West Plan Alternative

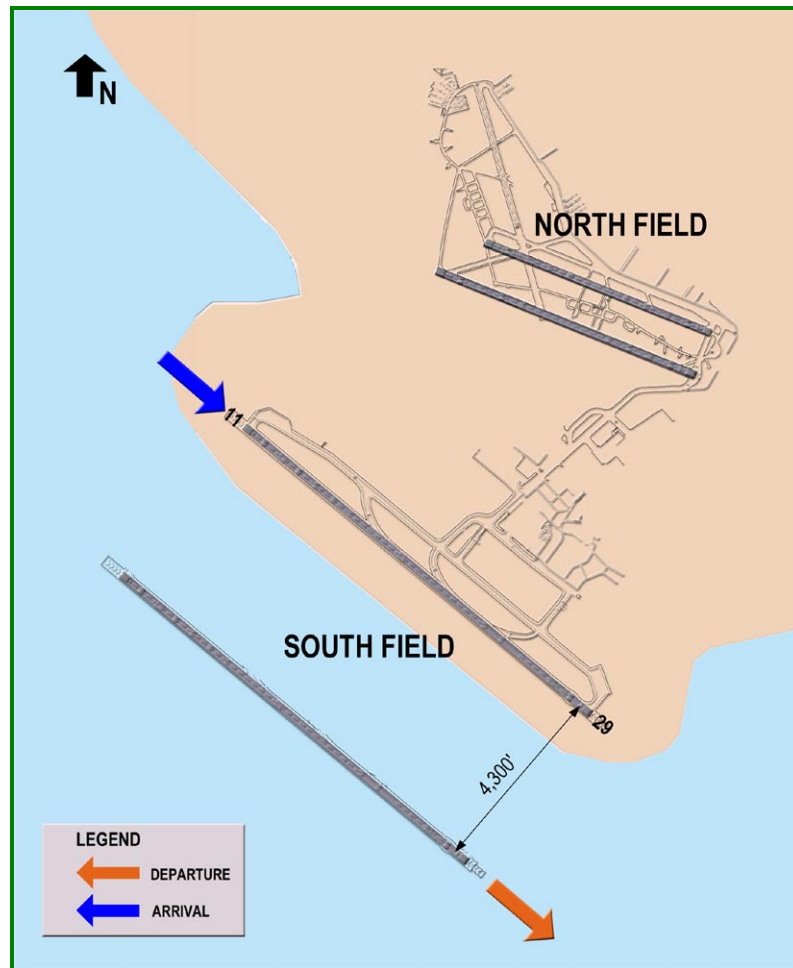


Figure 5-10 OAK Outboard Southeast Plan Alternative

Using the outboard runway for arrivals could impact aircraft landing on SFO's runways 19 due to insufficient vertical separation between the two arrival streams (this applies to aircraft landing on SFO's existing runways as well as the reconfigured runway option). Since it was not the purpose of this modeling effort to solve these types of airspace interactions, the operation of the runways was established to minimize interactions which resulted in assuming arriving aircraft would land on runway 11L (the existing runway) and take off on the new outboard runway 11R. This is different from most airport operations where departures use the runway closest to the terminal, which provides more efficient aircraft circulation.

5.3 SJC RUNWAY OPTIONS

As discussed in Section 3 and shown in Figure 3-8, SJC currently has a single commercial carrier runway, 12R/30L. However, the airport is presently extending the length of runway 12L/30R to enable it to be used for air carrier operations.

With the development of 12L/30R, SJC will have two full-length closely spaced parallel runways. This will moderately increase runway capacity during VFR conditions, but would not increase capacity during IFR conditions. Since construction of the extension will be complete by early 2001, dual runways for SJC are used in the simulation for future years.

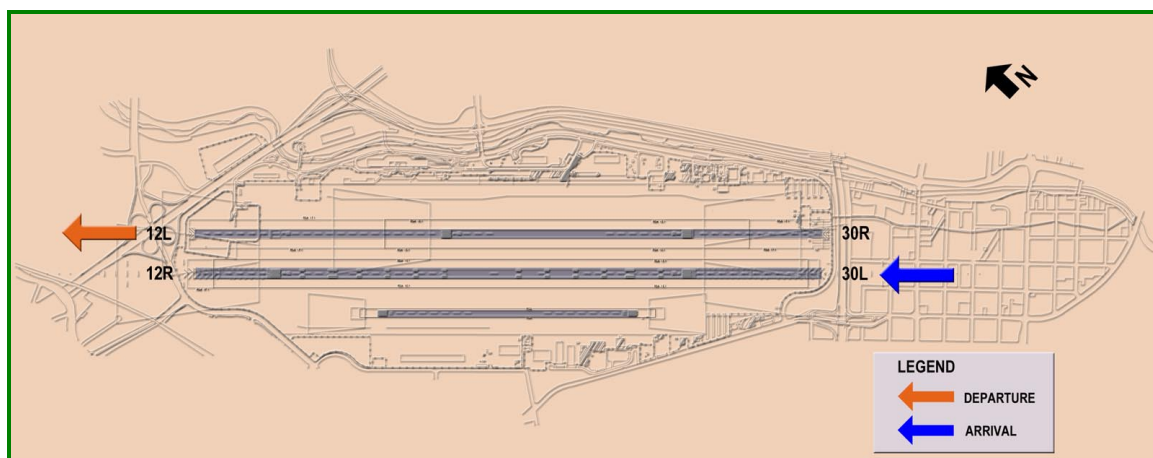


Figure 5-11 SJC Dual Runway West Plan Alternative

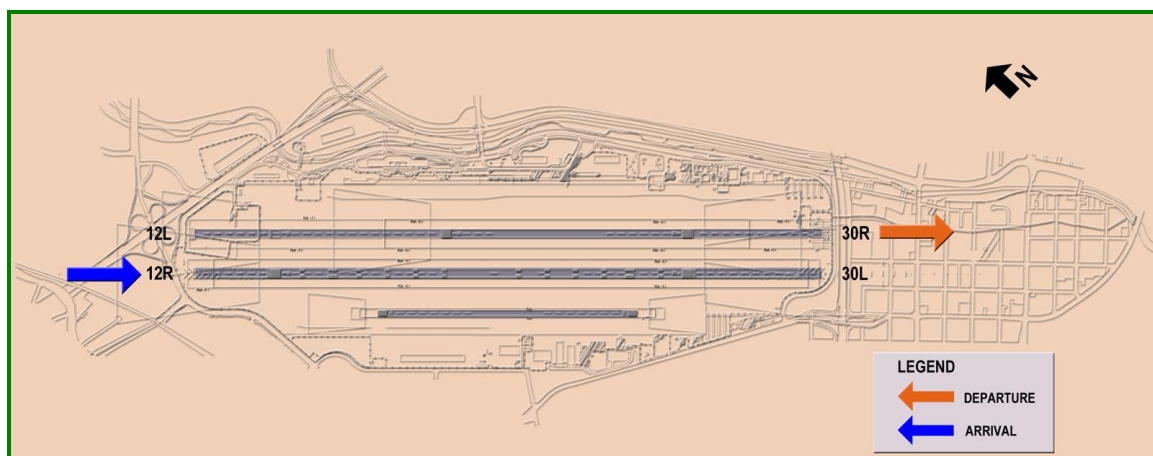


Figure 5-12 SJC Dual Runway Southeast Plan Alternative

5.4 COMBINATIONS OF BAY AREA RUNWAY OPTIONS

The runway alternatives described above have been modeled in different combinations in order to test the impacts on delays and the interaction of airspace routes and procedures between the three airports.

As shown in Table 5-1, a total of 13 simulations of new runway configurations were conducted for the A3, F2 and BXR alternatives at SFO and the different runway options possible at OAK. Three simulations were run against 2010 levels of traffic, 9 against 2020 levels of traffic and, for the BXR alternative, one additional simulation was run which reflects the reduced in-trail separation that future technologies may allow (an in-trail reduction to 3 nm).

Table 5-1
Runway Combinations Simulated

Case	Runway Configurations			Traffic Demand Level		
	SFO	OAK	SJC	1999	2010	2020
1	Existing	Existing	Existing/Master Plan	X	X*	X*
2	A3	Existing	Dual runways		X	X
3	A3	Inboard	Dual runways			X
4	A3	Outboard	Dual runways			X
5	F2	Existing	Dual runways		X	X
6	F2	Inboard	Dual runways			X
7	F2	Outboard	Dual runways			X
8	BXR	Existing	Dual runways		X	X
9	BXR	Inboard	Dual runways			X
10	BXR	Outboard	Dual runways			X
11	BXR + ATC **	Outboard	Dual runways			X

* 2010 and 2020 includes SOIA/PRM at SFO and second new air carrier runway at SJC

** Simulation of BXR with reduced in-trail separation of 3 nm to model the impact of new ATC Technology

5.5 FUTURE AIRSPACE NETWORK AND OPERATING PROCEDURES

The approach/departure procedures shown in Section 3 in Figures 3-8 and 3-9 illustrate the current use of the airspace over the Bay Area for West Plan and Southeast Plan conditions. For VFR conditions, the airspace use was assumed to remain the same as for current VFR operations. In the West Plan IFR, however, all the arriving routes for SFO will merge over San Jose into two separate 20 nm long approach streams feeding runways 28L and 28R. For the Southeast Plan IFR the only SFO alternative with dual arrivals will be the BXR alternative, while the A3 and F2 alternatives will use the same single approach procedure to runway 19L as is used currently.

5.6 PROJECTED DELAYS

As described in Section 4, flight schedules for 2010 and 2020 for each airport have been forecasted and used in the simulations to determine delays for each of the runway alternatives shown in Table 5-1. In order to provide a summary overview of the 13 simulations conducted, the following text will discuss the weighted averages for the three Bay Area airports as a whole. For delay information at each airport under each operating condition, the reader should refer to the detailed results shown in Tables 5-2 through 5-14.

5.6.1 Alternative A3 Delays

With reference to Table 5-2, the weighted average for the three Bay Area airports indicates that, at 2010 levels of traffic without the addition of a new runway at OAK, arrival delays will average 7.49 minutes per flight while departure delays will average 7.63 minutes per flight.

Table 5-3 indicates that the Bay Area average delay, at 2020 levels of traffic without the addition of a new runway at OAK, will rise to 13.11 minutes per arrival and 33.79 minutes per departure.

Table 5-4 indicates that the Bay Area average delay, with the addition of an inboard runway at OAK and 2020 levels of traffic, will be 12.92 minutes per arrival and 22.86 minutes per departure.

Table 5-5 indicates that the Bay Area average delay, with the addition of an outboard runway at OAK and 2020 levels of traffic, will be similar to the inboard runway alternative at 12.92 minutes per arrival and 22.82 minutes per departure.

5.6.2 Alternative F2 Delays

With reference to Table 5-6, the weighted average for the three Bay Area airports indicates that, at 2010 levels of traffic without the addition of a new runway at OAK, arrival delays will average 7.39 minutes per flight while departure delays will average 3.23 minutes per flight.

Table 5-7 indicates that the Bay Area average delay, at 2020 levels of traffic without the addition of a new runway at OAK, will rise to 12.79 minutes per arrival and 16.53 minutes per departure.

Table 5-8 indicates that the Bay Area average delay, with the addition of an inboard runway at OAK and 2020 levels of traffic, will be 12.78 minutes per arrival and 4.55 minutes per departure.

Table 5-9 indicates that the Bay Area average delay, with the addition of an outboard runway at OAK and 2020 levels of traffic, will be 12.82 minutes per arrival and 4.65 minutes per departure.

5.6.3 Alternative BXR Delays

With reference to Table 5-10, the weighted average for the three Bay Area airports indicates that, at 2010 levels of traffic without the addition of a new runway at OAK, arrival delays will average 2.54 minutes per flight while departure delays will average 2.55 minutes per flight.

Table 5-11 indicates that the Bay Area average delay, at 2020 levels of traffic without the addition of a new runway at OAK, will rise to 4.39 minutes per arrival and 16.93 minutes per departure. This large increase in departure delays is due to Oakland departure delays which have jumped to 46 min. This indicates that the capacity of OAK with a single commercial runway has been exceeded.

Table 5-12 indicates that the Bay Area average delay, with the addition of an inboard runway at OAK and 2020 levels of traffic, will be 4.41 minutes per arrival and 4.30 minutes per departure.

Table 5-13 indicates that the Bay Area average delay, with the addition of an outboard runway at OAK and 2020 levels of traffic, will be 4.02 minutes per arrival and 4.35 minutes per departure.

Table 5-14 indicates that the Bay Area average delay, with the addition of an outboard runway at OAK, advanced ATC technology at all three airports, and 2020 levels of traffic, will be 3.27 minutes per arrival and 3.59 minutes per departure.

5.6.4 Oakland Inboard versus Outboard Runway

While the tables show very little difference in the average delays at Oakland International Airport for inboard and outboard runway configurations, this reflects the SIMMOD modeling assumptions, rather than the actual capacity differences. The SIMMOD analysis made the simplifying assumption that all arrivals would use one runway and all departures would use the other runway. However, during peak arrival periods a properly spaced outboard runway would permit simultaneous arrivals during both VFR and IFR conditions (e.g., low level stratus clouds common in the Bay Area during summer months). This additional capacity was not evaluated, since the projected flight activity in 2020 could be accommodated using one runway for arrivals and the other for departures. Further evaluation would be required to determine the potential for delay reduction associated with an outboard runway compared to an inboard runway.

Table 5-2 Case 2 – SFO A3 and OAK Existing – 2010 Average Delays

Alternatives	2010 Arrival Delays (min)				2010 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	693	4.74	0.13	4.86	685	1.11	0.05	2.93	4.09	1378	4.48
West IFR	693	4.74	0.14	4.88	685	0.63	0.04	50.34	51.01	1378	27.81
SE IFR	693	132.1	0.02	133.14	685	1.62	0.06	1.07	2.75	1378	68.32
Weighted Avg.	693			11.47	685				11.07	1378	11.27
OAK											
West VFR	317	3.25	0.00	3.25	383	2.18	0.01	1.25	3.44	700	3.35
West IFR	317	2.63	0.41	3.04	383	1.34	2.36	10.87	14.64	700	9.39
SE IFR	317	4.90	0.23	4.62	383	2.75	0.00	2.51	5.26	700	4.97
Weighted Avg.	317			3.30	383				5.01	700	4.24
SJC											
West VFR	268	1.94	0.25	2.19	271	0.15	1.49	1.06	2.69	539	2.44
West IFR	268	1.47	0.25	1.72	271	0.09	1.60	1.07	2.77	539	2.25
SE IFR	268	1.85	0.17	2.02	271	0.49	0.27	1.22	1.99	539	2.00
Weighted Avg.	268			2.15	271				2.64	539	2.39
Bay Area											
Weighted Avg.	1278			7.49	1339				7.63	2617	7.56

Table 5-3 Case 2 – SFO A3 and OAK Existing – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	7.44	0.14	7.57	813	0.75	0.07	21.74	22.55	1634	15.02
West IFR	821	8.61	0.14	8.75	813	0.54	0.05	161.30	161.9	1634	84.95
SE IFR	821	246.80	0.00	246.80	813	1.54	0.05	4.14	5.73	1634	126.86
Weighted Avg.	821			20.08	813				42.62	1634	31.29
OAK											
West VFR	414	4.91	0.22	5.13	479	1.38	1.33	5.77	8.55	893	6.96
West IFR	414	4.12	0.00	4.12	479	1.42	0.00	233.90	235.3	893	128.12
SE IFR	414	28.00	0.25	28.28	479	2.37	0.00	5.69	8.06	893	17.43
Weighted Avg.	414			6.31	479				38.19	893	23.41
SJC											
West VFR	355	3.58	1.74	5.32	358	0.11	5.83	1.49	8.39	713	6.86
West IFR	355	2.55	0.41	2.96	358	0.05	3.65	1.41	5.17	713	4.07
SE IFR	355	2.13	0.22	2.36	358	0.74	1.43	2.13	4.30	713	3.33
Weighted Avg.	355			4.94	358				7.87	713	6.41
Bay Area											
Weighted Avg.	1590			13.11	1650				33.79	3240	23.64

Table 5-4

Case 3 – SFO A3 and OAK Inboard - 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	8.61	0.14	8.75	813	0.68	0.06	21.21	21.95	1634	15.32
West IFR	821	8.61	0.14	8.75	813	0.59	0.05	161.9	162.5	1634	85.25
SE IFR	821	246.6	0.03	246.7	813	1.54	0.04	4.09	5.68	1634	126.7
Weighted Avg.	821			21.01	813				42.22	1634	31.57
OAK											
West VFR	414	4.12	0.00	4.12	479	1.69	0.05	1.23	2.96	893	3.50
West IFR	414	4.08	0.00	4.08	477	1.44	0.04	2.91	4.40	891	4.25
SE IFR	414	27.84	0.25	28.08	479	0.39	0.00	3.66	6.05	893	16.26
Weighted Avg.	414			5.48	478				3.32	892	4.32
SJC											
West VFR	355	2.55	0.35	2.91	358	0.07	3.44	1.45	4.98	713	3.95
West IFR	353	2.54	0.44	2.98	356	0.08	3.69	1.41	5.27	709	4.13
SE IFR	355	2.13	0.22	2.35	358	0.83	1.70	2.08	4.62	713	3.49
Weighted Avg.	354			2.87	357				4.97	712	3.92
Bay Area											
Weighted Avg.	1589			12.92	1649				22.86	3238	17.98

Table 5-5
Case 4 – SFO A3 and OAK Outboard – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	8.61	0.14	8.75	813	0.68	0.06	21.21	21.95	1634	15.32
West IFR	821	8.61	0.14	8.76	813	0.61	0.05	163.2	162.5	1634	85.25
SE IFR	821	246.7	0.03	246.8	813	1.54	0.05	4.14	5.73	1634	126.8
Weighted Avg.	821			21.02	813				42.23	1634	31.57
OAK											
West VFR	414	4.12	0.00	4.12	479	1.69	0.05	1.23	2.96	893	3.50
West IFR	414	4.12	0.00	4.12	479	1.60	0.04	1.22	2.86	893	3.44
SE IFR	414	28.03	0.25	28.28	479	2.37	0.00	5.69	8.06	893	17.43
Weighted Avg.	414			5.49	479				3.24	893	4.28
SJC											
West VFR	355	2.55	0.35	2.91	358	0.07	3.44	1.45	4.98	713	3.95
West IFR	355	0.55	0.44	2.99	358	0.11	3.70	1.41	5.30	713	4.15
SE IFR	355	2.13	0.22	2.36	358	0.74	1.43	2.13	4.30	713	3.33
Weighted Avg.	355			2.87	358				4.94	713	3.91
Bay Area											
Weighted Avg.	1590			12.92	1650				22.82	3240	17.96

Table 5-6
Case 5 – SFO F2 and OAK Existing – 2010 Average Delays

Alternatives		2010 Arrival Delays (min)			2010 Departure Delays (min)				Total Delays (min)		
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	693	4.59	0.04	4.63	685	0.94	0.14	1.24	2.33	1378	3.49
West IFR	693	4.67	0.04	4.71	685	1.15	0.29	1.17	2.61	1378	3.67
SE IFR	693	132.1	0.01	132.1	685	1.45	0.05	1.28	2.78	1378	67.86
Weighted Avg.	693			11.22	685				2.40	1378	6.83
OAK											
West VFR	317	3.25	0.06	3.31	383	1.99	0.00	1.65	3.64	700	3.49
West IFR	317	3.25	0.07	3.33	383	2.62	0.72	12.79	16.1	700	10.33
SE IFR	317	3.85	2.16	6.01	383	2.38	0.00	1.63	4.01	700	4.92
Weighted Avg.	317			3.47	383				5.30	700	4.47
SJC											
West VFR	268	1.94	0.25	2.19	271	0.15	1.29	1.05	2.48	539	2.34
West IFR	268	1.94	0.24	2.18	271	0.14	1.17	1.01	2.31	539	2.25
SE IFR	268	1.21	0.17	1.38	271	0.74	0.13	1.15	2.03	539	1.71
Weighted Avg.	268			2.12	271				2.43	539	2.28
Bay Area											
Weighted Avg.	1278			7.39	1339				3.23	2617	5.26

Table 5-7
Case 5 – SFO F2 and OAK Existing – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	6.41	0.05	6.41	813	1.21	0.15	2.35	3.72	1634	5.07
West IFR	821	11.79	0.06	11.85	813	1.07	0.17	2.21	3.44	1634	7.67
SE IFR	821	247.20	0.02	247.20	813	1.44	0.05	4.44	5.94	1634	127.16
Weighted Avg.	821			19.64	813				3.79	1634	11.75
OAK											
West VFR	414	4.91	0.03	4.94	479	1.47	0.13	7.02	8.63	893	6.92
West IFR	414	4.91	0.04	4.95	479	3.90	0.00	286.70	290.6	893	158.17
SE IFR	414	28.46	4.94	33.41	479	2.27	0.00	4.66	6.90	893	19.19
Weighted Avg.	414			6.56	479				45.42	893	27.40
SJC											
West VFR	355	3.58	0.83	4.41	358	0.04	5.12	1.52	7.07	713	5.75
West IFR	355	3.58	0.62	4.20	358	0.06	4.60	1.47	6.33	713	5.27
SE IFR	355	2.13	0.23	2.36	358	0.66	1.43	2.09	4.19	713	3.28
Weighted Avg.	355			4.23	358				6.80	713	5.52
Bay Area											
Weighted Avg.	1590			12.79	1650				16.53	3240	14.70

Table 5-8 Case 6 – SFO F2 and OAK Inboard – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	6.41	0.05	6.46	813	1.14	0.16	2.14	3.44	1634	4.96
West IFR	821	11.79	0.06	11.85	813	1.23	0.15	2.16	3.54	1634	7.72
SE IFR	821	247.4	0.02	247.4	813	1.40	0.05	4.43	5.88	1634	127.2
Weighted Avg.	821			19.69	813				3.58	1634	11.67
OAK											
West VFR	414	4.91	0.06	4.97	479	3.35	0.00	1.37	4.72	893	4.84
West IFR	414	4.91	0.04	4.96	479	2.46	0.00	3.63	6.09	893	5.57
SE IFR	414	28.61	4.41	33.02	479	2.26	0.00	2.59	4.85	893	17.91
Weighted Avg.	414			6.56	479				4.91	893	5.67
SJC											
West VFR	355	3.58	0.61	4.19	358	0.08	4.62	1.50	6.40	713	5.30
West IFR	355	3.58	0.87	4.45	358	0.08	4.90	1.47	6.85	713	5.66
SE IFR	355	2.13	0.24	2.37	358	0.76	1.44	2.03	4.23	713	3.30
Weighted Avg.	355			4.06	358				6.25	713	5.16
Bay Area											
Weighted Avg.	1590			12.78	1650				4.55	3240	8.59

Table 5-9 Case 7 – SFO F2 and OAK Outboard – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	6.41	0.05	6.46	813	1.19	0.14	2.32	3.65	1634	5.06
West IFR	821	11.79	0.06	11.85	813	1.21	0.18	2.13	3.53	1634	7.71
SE IFR	821	247.4	0.02	247.4	813	1.40	0.05	4.43	5.88	1634	127.23
Weighted Avg.	821			19.69	813				3.75	1634	11.76
OAK											
West VFR	414	4.91	0.14	5.05	479	3.64	0.00	1.08	4.72	893	4.87
West IFR	414	4.91	0.13	5.04	479	3.72	0.00	1.10	4.82	893	4.92
SE IFR	414	28.61	4.41	33.02	479	2.26	0.00	2.59	4.85	893	17.91
Weighted Avg.	414			6.64	479				4.74	893	5.62
SJC											
West VFR	355	3.58	0.76	4.34	358	0.09	4.86	1.52	6.82	713	5.59
West IFR	355	3.58	0.47	4.05	358	0.09	4.33	1.44	5.97	713	5.01
SE IFR	355	2.13	0.24	2.37	358	0.76	1.44	2.03	4.23	713	3.30
Weighted Avg.	355			4.17	358				6.56	713	5.37
Bay Area											
Weighted Avg.	1590			12.82	1650				4.65	3240	8.66

Table 5-10 Case 8 – SFO BXR and OAK Existing – 2010 Average Delays

Alternatives	2010 Arrival Delays (min)				2010 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	693	3.16	0.07	3.23	685	0.13	0.01	1.76	1.90	1378	2.57
West IFR	693	2.63	0.08	2.71	685	1.31	0.01	1.91	3.24	1378	2.97
SE IFR	693	3.73	0.06	3.79	685	1.69	0.12	3.58	5.39	1378	4.59
Weighted Avg.	693			3.18	685				2.28	1378	2.73
OAK											
West VFR	317	0.27	0.00	2.27	383	0.05	0.00	2.70	2.75	700	2.53
West IFR	317	2.34	0.00	2.34	383	1.71	0.00	0.69	2.40	700	2.37
SE IFR	317	5.53	0.00	5.53	383	2.59	0.00	2.60	5.19	700	5.34
Weighted Avg.	317			2.46	383				2.84	700	2.67
SJC											
West VFR	268	0.91	0.01	0.92	271	0.01	0.00	2.97	2.99	539	1.96
West IFR	268	1.77	0.24	2.00	271	0.01	0.00	2.51	2.52	539	2.26
SE IFR	268	0.55	0.01	0.56	271	0.72	0.00	0.58	1.30	539	0.93
Weighted Avg.	268			0.96	271				2.83	539	1.90
Bay Area											
Weighted Avg.	1278			2.54	1339				2.55	2617	2.54

Table 5-11 Case 8 – SFO BXR and OAK Existing – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	5.20	0.10	5.30	813	0.22	0.01	2.05	2.27	1634	3.79
West IFR	821	4.29	0.09	4.37	813	1.36	0.01	7.41	8.78	1634	6.56
SE IFR	821	18.68	0.03	18.71	813	2.06	0.16	14.36	16.58	1634	17.65
Weighted Avg.	821			5.85	813				3.99	1634	4.92
OAK											
West VFR	414	3.58	0.00	3.58	479	0.06	0.00	17.21	17.27	893	10.92
West IFR	414	3.65	0.00	3.65	479	2.13	0.00	232.40	234.6	893	127.53
SE IFR	414	8.91	0.00	8.91	479	2.16	0.00	20.10	22.26	893	16.07
Weighted Avg.	414			3.89	479				45.99	893	26.47
SJC											
West VFR	355	1.55	0.01	1.57	358	0.02	0.45	7.48	7.95	713	4.77
West IFR	355	2.85	0.31	3.17	358	0.01	0.41	7.34	7.76	713	5.47
SE IFR	355	0.78	0.02	0.80	358	0.83	0.00	0.81	1.64	713	1.22
Weighted Avg.	355			1.60	358				7.43	713	4.53
Bay Area											
Weighted Avg.	1590			4.39	1650				16.93	3240	10.78

Table 5-12 Case 9 – SFO BXR and OAK Inboard – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	5.20	0.09	5.29	813	0.22	0.00	2.11	2.33	1634	3.82
West IFR	821	4.13	0.09	4.22	813	1.39	0.01	8.43	9.80	1634	7.00
SE IFR	821	21.33	0.10	21.43	813	1.89	0.12	11.20	13.21	1634	17.34
Weighted Avg.	821			5.96	813				4.01	1634	4.99
OAK											
West VFR	414	3.47	0.00	3.47	479	0.14	0.02	0.94	1.10	893	2.20
West IFR	414	3.58	0.00	3.58	479	1.84	0.00	4.50	6.34	893	5.06
SE IFR	414	4.39	0.04	4.43	479	2.25	0.00	3.65	5.91	893	5.22
Weighted Avg.	414			3.54	479				2.06	893	2.74
SJC											
West VFR	355	1.55	0.10	1.86	358	0.02	0.94	7.71	8.66	713	5.27
West IFR	355	2.85	0.32	3.18	358	0.01	0.10	6.18	6.29	713	4.74
SE IFR	355	0.78	0.02	0.80	358	0.65	0.08	0.71	1.44	713	1.12
Weighted Avg.	355			1.85	358				7.94	713	4.91
Bay Area											
Weighted Avg.	1590			4.41	1650				4.30	3240	4.35

Table 5-13 Case 10 – SFO BXR and OAK Outboard – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	5.20	0.09	5.29	813	0.22	0.01	2.04	2.27	1634	3.79
West IFR	821	4.13	0.09	4.22	813	1.42	0.01	8.53	9.96	1634	7.08
SE IFR	821	23.34	0.02	23.36	813	1.77	0.15	19.13	21.06	1634	22.22
Weighted Avg.	821			6.06	813				4.39	1634	5.23
OAK											
West VFR	414	1.22	0.00	1.22	479	0.17	0.00	1.03	1.21	893	1.21
West IFR	414	4.04	0.12	4.16	479	2.22	0.00	0.80	3.02	893	3.55
SE IFR	414	8.68	0.13	8.81	479	2.76	0.00	0.89	3.65	893	6.04
Weighted Avg.	414			2.04	479				1.59	893	1.79
SJC											
West VFR	355	1.55	0.01	1.56	358	0.02	0.63	7.70	8.35	713	4.97
West IFR	355	2.85	0.33	3.19	358	0.01	1.90	8.87	10.77	713	7.00
SE IFR	355	0.78	0.03	0.81	358	0.74	0.00	0.87	1.61	713	1.21
Weighted Avg.	355			1.60	358				7.96	713	4.79
Bay Area											
Weighted Avg.	1590			4.02	1650				4.35	3240	4.19

Table 5-14
Case 11 – SFO BXR and OAK Outboard with Advanced ATC – 2020 Average Delays

Alternatives	2020 Arrival Delays (min)				2020 Departure Delays (min)					Total Delays (min)	
	Ops	Air	Ground	Total	Ops	Air	Ground	Queue	Total	Ops	Total
SFO											
West VFR	821	5.18	0.08	5.26	813	0.28	0.01	1.61	1.90	1634	3.59
West IFR	821	2.24	0.09	2.33	813	1.50	0.01	7.25	8.76	1634	5.53
SE IFR	821	1.31	0.06	1.37	813	2.24	0.15	3.15	5.54	1634	3.44
Weighted Avg.	821			4.62	813				3.12	1634	3.87
OAK											
West VFR	414	1.22	0.00	1.22	479	0.14	0.00	0.92	1.06	893	1.13
West IFR	414	4.04	0.11	4.14	479	2.17	0.00	0.84	3.01	893	3.53
SE IFR	414	8.68	0.16	8.84	479	2.86	0.00	0.81	3.67	893	6.07
Weighted Avg.	414			2.03	479				1.46	893	1.73
SJC											
West VFR	355	1.55	0.01	1.56	358	0.02	0.68	7.43	8.14	713	4.86
West IFR	355	2.85	0.34	3.19	358	0.01	0.10	6.40	6.51	713	4.86
SE IFR	355	0.78	0.02	0.81	358	0.81	0.00	0.84	1.65	713	1.23
Weighted Avg.	355			1.60	358				7.52	713	4.57
Bay Area											
Weighted Avg.	1590			3.27	1650				3.59	3240	3.44

5.7 ULTIMATE RUNWAY CAPACITY

Ultimate runway capacity for an airport can be defined as the maximum number of aircraft operations that could be handled in one hour with acceptable levels of delay given a specific runway configuration. The limit of acceptable delays should not be much greater than an average of 5 minutes per aircraft, as discussed in Section 2 above.

By increasing progressively the number of operations until delays exceed 5 minutes, the ultimate capacity of a runway alternative can be established. The ultimate capacities for each airport and runway configuration, as calculated using SIMMOD, are shown in Table 5-15.

These estimates were developed with the SIMMOD Plus version of the airport and airspace simulation model. Calculated capacities may be different with other versions of SIMMOD model, incorporation of more detail for weather conditions (while this analysis evaluated three major weather conditions, there are further variations of each which, when weighted for their frequency of occurrence, could result in different and possibly high hourly capacities), incorporation of alternative taxiway layouts, aircraft gate assignments and gate hold procedures, etc.

**Table 5-15
Ultimate Airport Capacity**

Total Operations per Hour			
Alternative	VFR	IFR	Weighted Average
SFO			
Existing	99	71	93
A3	108	99	106
F2	128	110	124
BXR	128	114	125
BXR/ New Tech	129	116	126
OAK			
Existing	49	47	49
Inboard	84*	60	80
Outboard	98*	76**	95
SJC			
Existing	78*	40	72
Dual Runways	78*	43	72

* The numbers in this study are based on single streams for arrivals/departures for simplicity in modeling. In reality, VFR capacity would be higher since dual arrivals are possible.

** IFR capacities would also be higher at OAK with dual arrivals made possible with a properly separated outboard runway.